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CURRENT HEARING THRESHOLD LEVELS FOR NOISE-EXPOSED U.S. AIR FORCE PERSONNEL: ONE YEAR'S REPORTINGS

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USAF SCHOOL OF AEROSPACE MEDICINE
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NOTICES

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This technical report has been reviewed and is approved for publication.

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The hearing threshold levels of noise-exposed U.S. Air Force military and civilian personnel are presented and compared to the general, noninstitutionalized U.S. population. The U.S. Air Force military personnel show better hearing than the U.S. Air Force civilians or the U.S. population. The Air Force civilians have hearing as good as or better than the U.S. population except at the higher audiometric frequencies in the 45-54-year age range. The relatively good hearing for noise-exposed U.S.

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20. ABSTRACT (CONTINUED)

Air Force personnel is attributed partly to the exercise of minimum hearing level entrance requirements. However, the existence of a comprehensive hearing conservation program since 1956 is probably the main contributor to the good hearing in spite of exposure to potentially hazardous noise.

CURRENT HEARING THRESHOLD LEVELS FOR NOISE-EXPOSED U.S. AIR FORCE PERSONNEL: ONE YEAR'S REPORTINGS

INTRODUCTION

In 1956, the U.S. Air Force--on the basis that noise could be hazardous to hearing--established a detailed Air Force-wide hearing conservation program. AFR 160-3, Hazardous Noise Exposure (1), had provisions for identifying potentially hazardous noise areas, indoctrinating affected personnel, reducing level and/or time of exposure, providing personal ear protection, monitoring audiometry, and planning disposition of personnel. Monitoring audiometry imposed at least annual pure-tone threshold testing on all persons who were considered to be exposed to potentially hazardous noise. A carbon copy of each audiogram is sent to the USAF Hearing Conservation Data Registry, Brooks AFB, Texas. Prior to 1973 these copies were arriving at Brooks AFB at the rate of about 100,000 per year. In 1973, a new regulation, AFR 161-35, Hazardous Noise Exposure (2), stimulated an increase to about 250,000 per year. Computer storage of these data did not begin until January 1975. Prior to 1975, only broad generalizations or studies of hand-drawn samples were feasible. Computer storage now permits the study of all data received.

The purpose of this study was to determine the hearing threshold level for noise-exposed U.S. Air Force personnel and to compare the findings to those reported by the U.S. Public Health Service for the general U.S. population in Hearing Levels of Adults by Age and Sex (5).

A primary intention was to include all noise-exposed USAF personnel rather than to draw a sample. Since each such member is required to have an audiogram at least annually, it was assumed that inclusion of all audiograms dated within a 1-year period would provide the desired group. In a previous report, Sutherland and Gasaway (6) described hearing levels contained in forms that were received within a 6-month period.

METHOD

Forms with an audiogram date of 1 June 1975 through 31 May 1976 (1 full year) were selected for this study. Audiograms received at the Registry may have been made for any one of several purposes. A large number are reference audiograms on individuals newly assigned to duties in noise. The largest percentage of forms received are "annual" audiograms. Each annual audiogram has the current hearing threshold levels as well as a transcription of the respective person's reference levels. The first annual audiogram is done 1 year after the reference examination. The examiner computes threshold shift at each frequency, and then determines whether

or not the criterion for significant threshold shift is met. Many forms document audiometry that is done for special followup when significant threshold shift appears on an annual audiogram. Only annual audiograms were included in this study. Therefore, all individuals represented have been included in the USAF Hearing Conservation Program for at least 1 year. Only one record per person was included, even though more than one was received on some individuals within the year.

Hearing threshold levels were extracted for audiometric frequencies 500, 1000, 2000, 3000, 4000, and 6000 Hz for age groups 18-24, 25-34, 35-44, 45-54, and 55-64, with military and civilian data kept separately.

RESULTS

Table 1 shows the number of audiograms included in this study, grouped according to the age of the respective military and civilian personnel. Approximately 85% of the total are military and about 15% are civilian. In age, military personnel are most numerous in the 25-34-year range and civilians are most numerous in the 45-54-year range. Further, 75% of the military are 34 years old or younger, whereas 71.5% of the civilians are 35 years old or older. The total number of members (117,454) is the entire noise-exposed Air Force population that received an annual hearing conservation audiogram in this 1-year period.

Median hearing threshold levels for each age range studied are in Table 2. Groups included are: 1) noise-exposed Air Force military personnel (AF-M); 2) noise-exposed Air Force civilian personnel (AF-C); and 3) the general noninstitutionalized United States population (HES). Medians for the population are taken from the U.S. Public Health Service Health Examination Survey (USPHS HES) of 1965 (5). The HES medians for men only were used. The HES audiometry was done with audiometers calibrated to the American Standard Specifications for Audiometers for General Diagnostic Purposes, 1951 (4). The medians from that survey were converted to the American National Standard Specifications for Audiometers, 1969 (3), reference for direct comparison with the Air Force audiometry. Calculation of calibration conversion values is reviewed in Table 3. Both the U.S. Public Health Service and the U.S. Air Force used TDH-39 earphones with MX-41/AR ear cushions.

Within the 18-24-year range the hearing threshold level (HTL) was about the same for military and civilian personnel, while the U.S. population was slightly poorer except for 500 Hz in the left ear (Table 2). Within the 25-34-year group the Air Force military personnel revealed better hearing than either of the other two groups, and the Air Force civilians showed generally better hearing than the general U.S. population. The 35-44-year group showed the same pattern as the 25-34-year group but at slightly poorer HTL's.

The Air Force military persons showed the best hearing in the 45-54-year group. In this same group, the Air Force civilians have about the same or better hearing than the general U.S. population in the three lower frequencies, but have slightly poorer hearing in the three higher frequencies.

The Air Force military personnel showed better hearing than the others in the 55-64-year range, as they did in all the other age groups. In this oldest group studied, the Air Force civilians and the general U.S. population showed about the same median HTL's--with the HTL of the Air Force civilians being very slightly better.

Figures 1 through 6 illustrate the relationship between age group and HTL. The curves reflect changes in median HTL with increasing age. At 500 Hz (Fig. 1), the U.S. Air Force military show the same or better hearing than the other groups at all ages and show less decrease in hearing with increasing age than do the others. The U.S. Air Force civilians have virtually the same hearing levels as the general U.S. population with the left ear, but are better at all ages with the right ear.

At 1000 Hz (Fig. 2), the USAF military has equivalent or better hearing than the other two groups at all ages. At this frequency, the U.S. Air Force civilians have about the same hearing as the general U.S. population, with both ears at all ages. At 2000 Hz (Fig. 3) the groups are more distinct than at any other frequency. The U.S. Air Force military has the best hearing, that of the U.S. Air Force civilians is next, and that of the general U.S. population is poorest. The only exception is in the 18-24-year range where the U.S. Air Force military and civilian groups have about the same hearing.

The pattern at 3000 Hz (Fig. 4) is about the same as that for 2000 Hz--except in the 45-54-year range. Within that range, the U.S. population shows better hearing than do the U.S. Air Force civilians. At 4000 Hz (Fig. 5) the same pattern emerges, except that the U.S. Air Force civilians and the U.S. population are more alike at ages 35-44 for the left ear, and at ages 55-64 for both ears. At 6000 Hz (Fig. 6), the pattern is virtually identical to that at 3000 Hz. The only major difference is that the hearing levels are poorer and the decrease in hearing with increasing age is sharper.

In summary, noise-exposed U.S. Air Force military personnel reflect better hearing than either noise-exposed U.S. Air Force civilians or the general noninstitutionalized U.S. population. The U.S. Air Force civilians show generally better hearing than the general U.S. population, except at higher audiometric frequencies in the 45-54-year range. Hearing levels become poorer with increasing age, except for the U.S. Air Force military, who showed slightly better hearing in the age range 25-34 than in the age range 18-24 at 500, 1000, and 2000 Hz. Differences between these two age groups of military personnel are slight, and in both the hearing levels are well within normal limits.

An incidental observation is that median hearing levels are consistently better for right ears than left ears. A point-by-point comparison shows right ear hearing better than left for all frequencies, ages, and groups--except at 500 and 1000 Hz, for the U.S. population only.

Table 4 gives the percentage distribution of hearing threshold levels for all frequencies, right and left ears, U.S. Air Force military and civilians, for each age group. The skewing expected with audiometric pure-tone threshold distributions is evidenced in the concentration of high percentages at or near the lower limit (<0), especially for the younger age groups. The percentage in each interval containing the median for that column is underlined. A strong central tendency is not apparent at the higher audiometric frequencies for the older groups. In the two oldest age groups at 3000, 4000, and 6000 Hz, the highest percentage in an interval containing a median is 13.6 at 3000 Hz, right ear, for military in age group 45-54.

DISCUSSION

The U.S. Air Force civilians in this study perform duties that are similar to those that would be done in any industry, military or not. About 60% of the civilians represented in this study are employed at large logistics type bases that have warehouse, manufacturing, and maintenance type activities.

The generally good hearing for noise-exposed U.S. Air Force personnel in comparison with that of the general U.S. population can be attributed in part to admission requirements. The 1956 Air Force hearing conservation regulation initiated a requirement for average hearing in the speech frequencies, 500-2000 Hz, to be better than 30 dB, ANSI (20 dB, ASA) in both ears, to enter duties in noise. The USPHS HES study (5) revealed that 1% of the U.S. population, age 18-24 years, would fail that criterion in the better ear. Since the Air Force rejects on the basis of the poorer ear, we know that over 1% of the 18-24-year-old general U.S. population would fail the entrance requirement. Moreover, the military members must meet additional criteria, which are particularly stringent for entry into flying training and some other special job categories. The special criteria specify: hearing no poorer than 25 dB, ANSI (15 dB, ASA), at 500, 1000, and 2000 Hz for both ears; and average hearing no poorer than 45 dB, ANSI (35 dB, ASA) at 3000, 4000, and 6000 Hz for both ears averaged together.

The relatively good hearing found for noise-exposed Air Force members in comparison with the general U.S. population is felt to be due largely to the hearing conservation program. The Air Force members were included in this study only if they were considered to be routinely exposed to noise levels that might be hazardous to hearing and were therefore a high risk group. The 1956 regulation, AFR 160-3 (1), designated an 8-hour exposure in a day to 85 dB in any of the octave bands 300-600 Hz, 600-1200 Hz, 1200-2400 Hz, or 2400-4800 Hz as the damage risk criteria. The permissible

daily time of exposure was reduced by one-half for each increase of 3 dB. The 1973 regulation (2) imposed 84 dB on the A-weighted setting of the sound level meter as the limit for 8 hours in one day. Permissible time of exposure is reduced by one-half for each 4-dB increase in the A-weighted level. Both regulations placed heavy reliance on personal ear protection (ear plugs and/or ear muffs) to reduce at-the-ear noise exposure.

The U.S. Air Force Hearing Conservation Program (old and new regulations the same) uses stringent criteria for significant threshold shift rather than significant hearing loss, to identify individuals for special followup. Threshold shift is calculated by comparing the current, usually annual, to the reference audiogram, regardless of time interval between the two. If the reference has no HTL poorer than 25 dB at any frequency, either ear, then a threshold shift of 20 dB or more at any frequency, either ear, is significant. If the reference has any HTL of 30 dB or greater, then a threshold shift in either ear of 10 dB or more at 2000 Hz, 15 dB or more at 3000 Hz, or 20 dB at 4000 or 6000 Hz is significant. The U.S. Air Force members in this study included 27,790 individuals who revealed significant threshold shift; that is, 23.7% of the total.

Special followups, when threshold shift is significant, consist of either one or two more audiograms after auditory rest to explore the possibility of temporary threshold shift or audiometric variance. Many individuals are then reeducated, refitted with ear protection, and returned to duty. Some are given an additional detailed followup which consists of five monthly audiograms. The objective is to ascertain if hearing levels have stabilized. If so, the person is returned to routine duty with a corrected reference audiogram. Very few persons must be removed from their jobs in noise because of noise-related threshold shift. It is possible for a person with relatively good hearing to reveal a significant threshold shift leading to special followup, issue of extra protection, and even possible retraining into noise-safe duties, even though his hearing is still quite good. Conversely a person with relatively poor hearing will receive only the routine annual monitoring as long as his hearing is stabilized. In January 1975, 18,746 audiometric records and 190 reports of special dispositions were received at the Hearing Conservation Data Registry, Brooks AFB, Texas. Only 32 reports contained the recommendation to remove a person from duties in noise because of threshold shift. This removal rate is considered very low.

ACKNOWLEDGMENTS

Primary contents of this paper were presented at the American Speech and Hearing Association Convention, Houston, Texas, November 1976. Raul Garcia and Richard Medina of the Biometrics Division, USAF School of Aerospace Medicine, planned and carried out all the computer storage and manipulation required for completion of this study.

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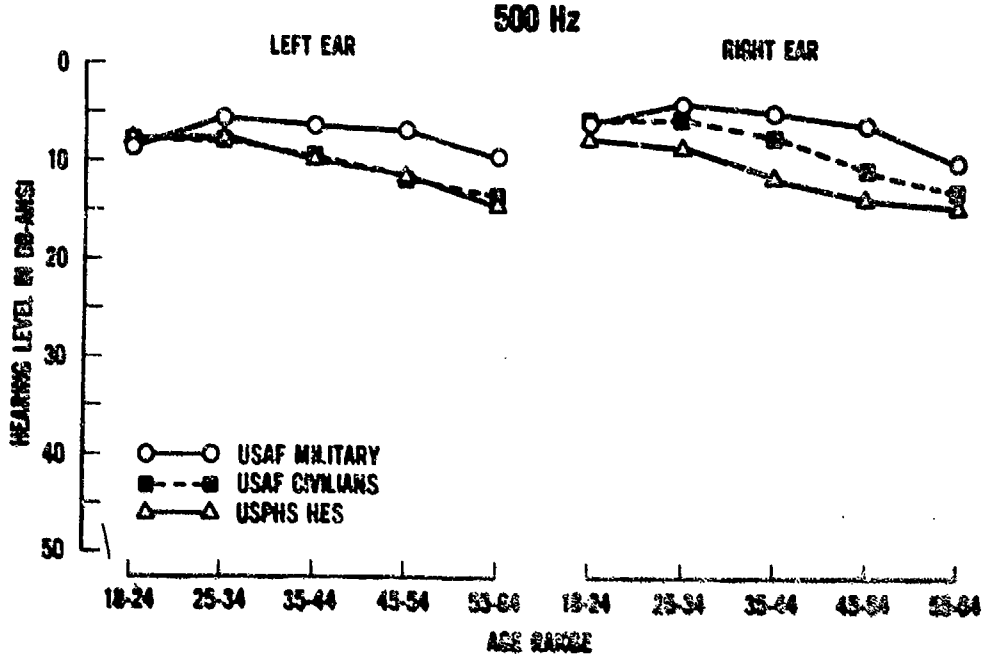

Figure 1. Median hearing threshold levels for military and civilian noise-exposed U.S. Air Force personnel and for the U.S. population at 500 Hz.

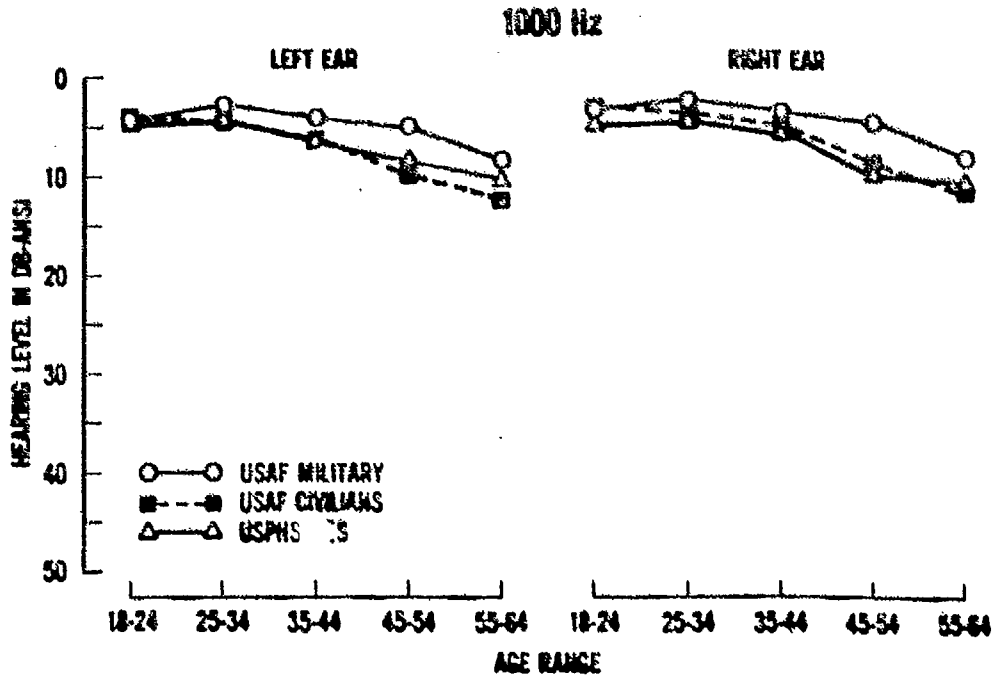

Figure 2. Median hearing threshold levels for military and civilian noise-exposed U.S. Air Force personnel and for the U.S. population at 1000 Hz.

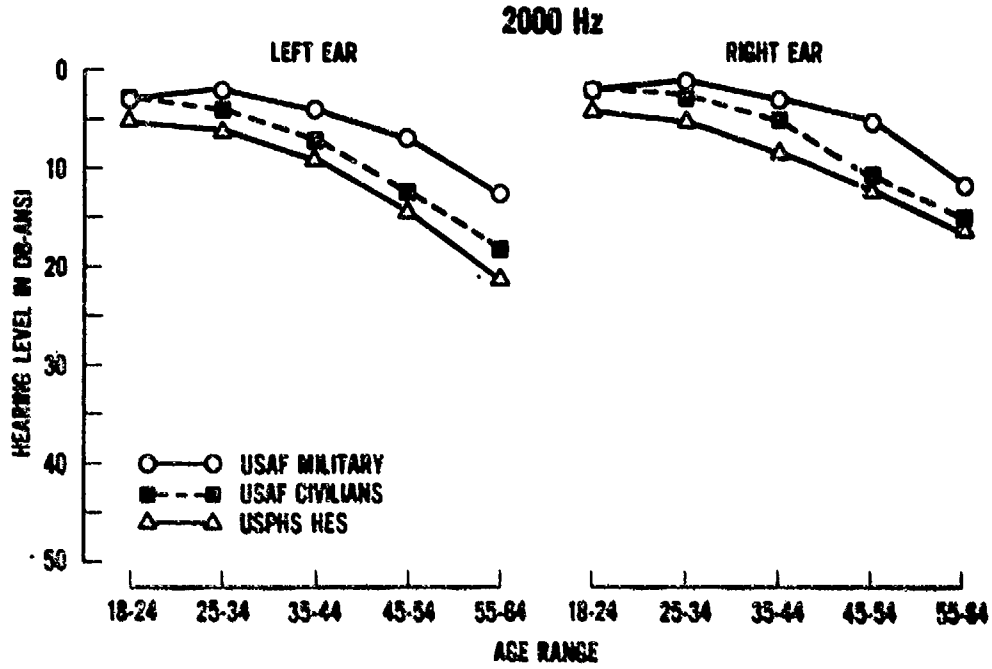

Figure 3. Median hearing threshold levels for military and civilian noise-exposed U.S. Air Force personnel and for the U.S. population at 2000 Hz.

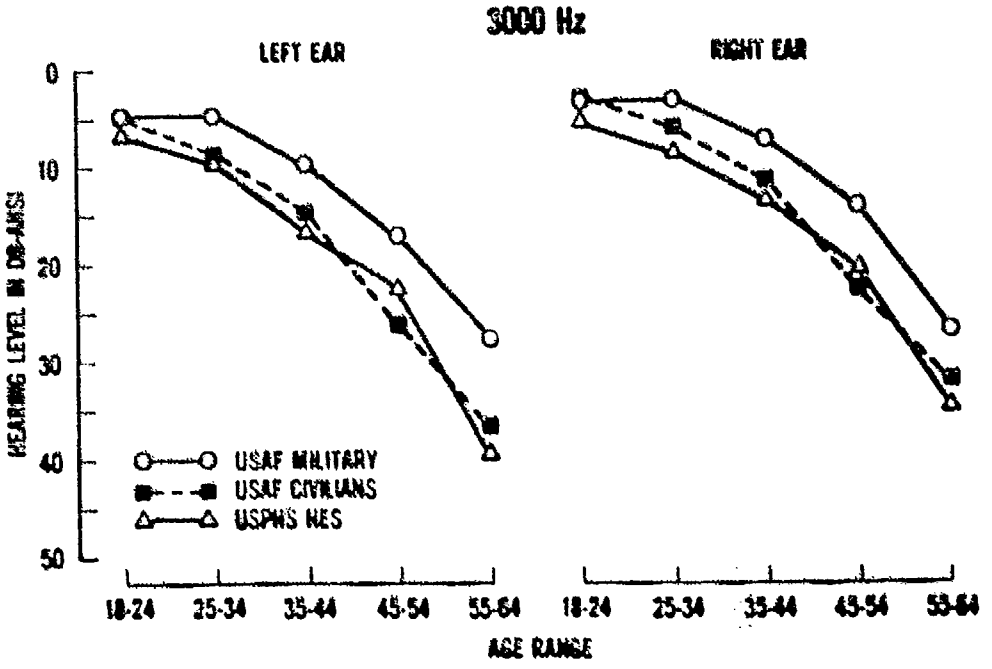

Figure 4. Median hearing threshold levels for military and civilian noise-exposed U.S. Air Force personnel and for the U.S. population at 3000 Hz.

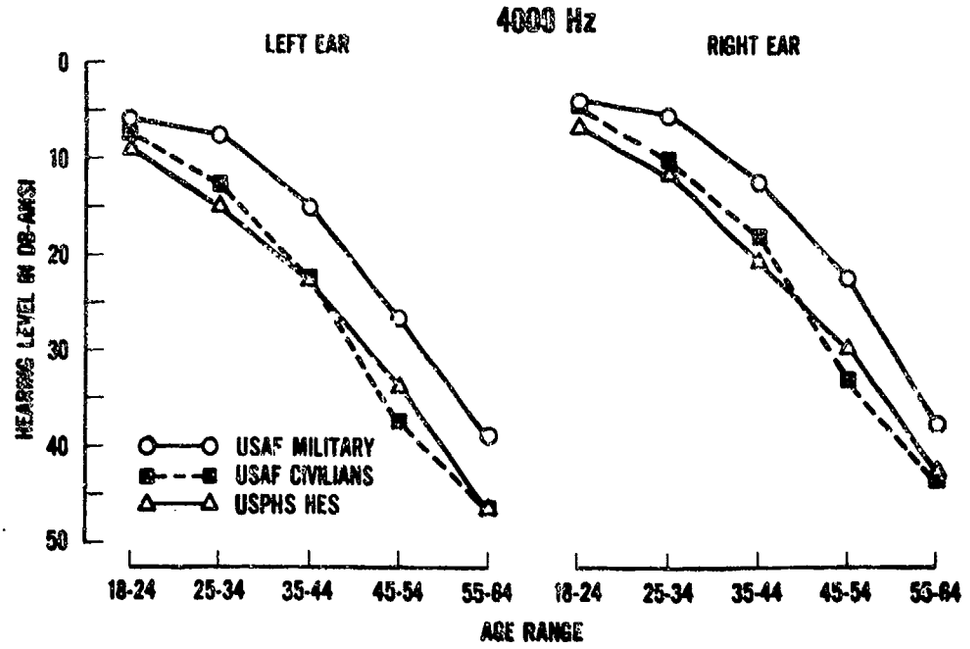

Figure 5. Median hearing threshold levels for military and civilian noise-exposed U.S. Air Force personnel and for the U.S. population at 4000 Hz.

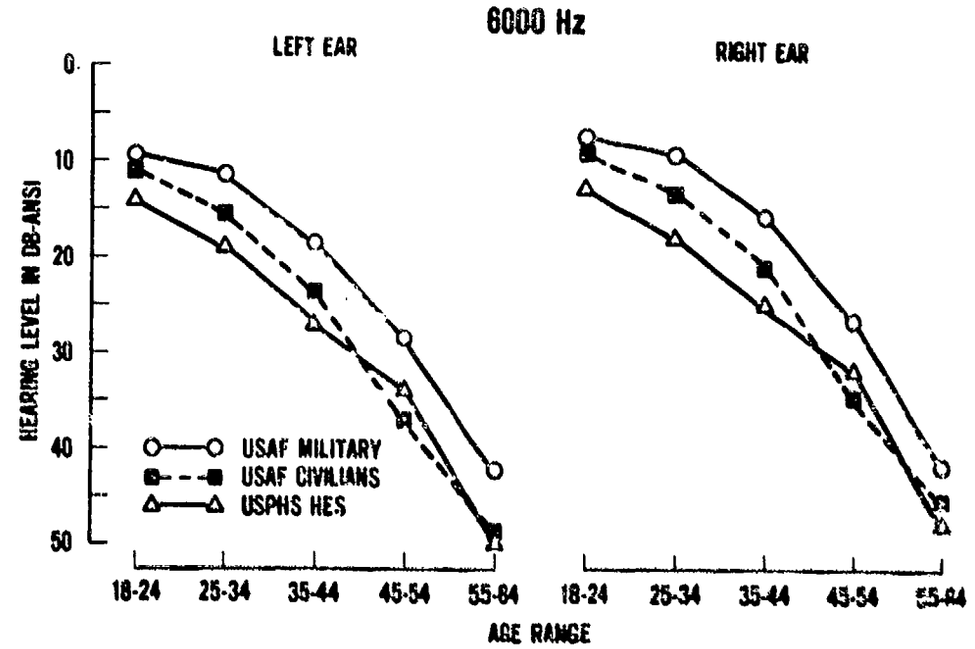

Figure 6. Median hearing threshold levels for military and civilian noise-exposed U.S. Air Force personnel and for the U.S. population at 6000 Hz.

TABLE 1. AUDIOMETRIC RECORDS FOR MILITARY AND CIVILIAN PERSONNEL

Age	Military		Civilian	
	Number	Percent	Number	Percent
18-24	29,853	30.1	669	3.7
25-34	44,572	44.9	4,500	24.8
35-44	21,189	21.3	4,174	23.0
45-54	3,340	3.4	5,691	31.4
55-64	364	.4	3,102	17.1
TOTALS	99,318	84.6	18,136	15.4

TOTAL = 117,454

TABLE 2. MEDIAN HEARING THRESHOLD LEVEL FOR NOISE-EXPOSED AIR FORCE MILITARY PERSONNEL (AF-M), AIR FORCE CIVILIAN PERSONNEL (AF-C), AND FOR THE GENERAL NONINSTITUTIONALIZED UNITED STATES POPULATION (HES)

	Left Ear Frequency (Hz)						Right Ear Frequency (Hz)					
Group	500	1000	2000	3000	4000	6000	500	1000	2000	3000	4000	6000
					Age 18-24							
AF-M	8.4	4.0	2.9	4.5	5.9	9.3	5.8	2.9	1.8	3.1	4.1	7.4
AF-C	7.7	3.5	2.6	4.8	7.2	10.9	5.6	2.7	1.8	2.8	4.3	9.1
HES	7.6	4.2	5.0	6.6	8.8	14.0	7.6	4.2	4.0	5.6	6.8	13.0
					Age 25-34							
AF-M	5.6	2.7	2.0	4.6	7.7	11.3	4.0	2.1	1.0	3.1	5.5	9.3
AF-C	7.8	4.2	3.8	8.6	12.7	15.4	5.6	3.3	2.5	5.9	10.1	13.3
HES	7.6	4.2	6.0	9.6	14.8	19.0	8.6	4.2	5.0	8.6	11.8	18.0
					Age 35-44							
AF-M	6.1	3.7	3.9	9.5	15.0	18.5	4.8	3.2	2.9	7.2	12.4	15.7
AF-C	9.1	6.0	6.8	14.5	22.6	23.7	7.3	4.8	4.7	11.3	18.1	21.0
HES	9.6	6.2	9.0	16.6	22.8	27.0	11.6	5.2	8.0	13.6	20.8	25.0
					Age 45-54							
AF-M	6.6	4.7	6.8	17.1	26.6	28.5	6.0	4.1	5.1	13.9	22.5	26.4
AF-C	11.7	9.6	12.2	26.0	37.2	37.1	10.5	8.2	10.3	22.3	33.3	34.6
HES	11.6	8.2	14.0	22.6	33.8	34.0	13.6	9.2	12.0	20.6	29.8	32.0
					Age 55-64							
AF-M	9.3	8.1	12.5	27.7	38.9	42.1	10.0	7.7	11.5	26.7	37.9	41.8
AF-C	13.5	12.0	18.0	36.6	46.5	48.9	12.8	11.1	14.8	31.7	43.8	45.4
HES	14.6	10.2	21.0	39.6	46.8	50.0	14.6	10.2	16.0	34.6	42.8	48.0

TABLE 3. AUDIOMETER ZERO REFERENCE STANDARDS USED BY USPHS (HES) AND U.S. AIR FORCE (VALUES GIVEN IN DECIBELS SOUND PRESSURE LEVEL)

Frequency (Hz)	HES ASA-1951	USAF ANSI-1969	Difference
500	24.1	11.5	12.6
1000	17.2	7.0	10.2
2000	18.0	9.0	9.0
3000	15.6	10.0	5.6
4000	14.3	9.5	4.8
6000	19.5	15.5	4.0

TABLE 4. PERCENT DISTRIBUTION OF HEARING THRESHOLD LEVEL

Age 18-24

Hearing Level (dB)	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
					MILITARY							
<0	9.3	23.9	33.2	27.4	24.0	17.8	15.0	30.0	39.3	32.9	28.8	21.0
5	22.8	32.8	28.6	25.2	22.8	18.2	31.0	34.9	30.0	28.1	26.1	20.9
10	26.6	21.3	17.5	18.3	18.0	16.4	25.4	19.0	15.4	17.2	16.8	17.1
15	24.2	13.6	11.7	13.9	14.6	16.1	17.7	10.2	8.8	11.3	12.3	15.1
20	9.7	4.5	4.5	6.3	7.2	10.3	5.8	3.3	3.2	4.4	5.6	8.9
25	4.6	2.1	2.4	3.7	4.6	7.3	2.9	1.5	1.5	2.6	3.5	5.9
30	1.3	.6	.9	1.7	2.2	3.8	.8	.6	.7	1.1	1.7	2.8
35	.8	.4	.5	1.1	1.6	2.5	.5	.4	.3	.8	1.3	2.0
40	.3	.2	.3	.7	1.1	1.6	.3	.2	.3	.5	.9	1.3
45	.2	.2	.2	.5	1.0	1.5	.2	.3	.2	.4	.8	1.1
50	.1	.1	.1	.3	.8	1.0	.1	.1	.1	.2	.6	.9
55	.1	.1	.1	.3	.7	.9	.1	.1	.1	.2	.5	.8
60	.1		.1	.2	.5	.7			.1	.1	.3	.5
65		.1		.1	.4	.6			.1	.1	.3	.5
70			.1	.1	.2	.5				.1	.2	.3
75				.1	.1	.3				.1	.1	.2
80					.1	.2					.1	.2
>80				.1	.1	.3				.1	.1	.3
					CIVILIAN							
< 0	10.8	25.3	34.2	27.4	21.5	13.8	14.1	28.9	38.0	33.8	26.3	17.9
5	24.8	35.9	30.2	23.6	21.7	18.1	32.7	38.9	34.1	29.0	27.8	18.1
10	26.3	20.8	17.5	18.2	15.7	15.4	25.9	16.6	13.6	14.8	14.9	16.9
15	21.5	10.0	10.3	11.7	15.8	15.3	15.3	8.7	7.5	10.6	10.3	14.1
20	9.0	4.0	3.3	5.3	6.9	9.7	5.8	2.8	3.6	4.3	5.8	7.9
25	4.9	2.8	1.6	4.5	4.8	7.5	3.3	2.7	1.4	2.4	2.5	7.3
30	1.1	.8	.9	1.6	3.1	4.2	2.1	.5	.5	.9	2.1	4.2
35	1.2	.3	.6	2.1	1.8	2.7	.6	.5	.2	.5	1.9	3.4
40	.2		.5	.8	1.4	2.5	.2	.6	.8	.8	1.4	1.6
45	.3		.5	.5	1.4	3.1			.6	1.1	1.5	2.1
50		.2	.3	1.1	1.1	1.9	.2			.3	1.2	1.4
55			.2	1.1	1.2	1.2				.6	1.1	.6
60				.9	1.1	1.2				.6	.6	.9
65				.3	1.2	1.2				.2	.5	1.4
70				.2	.3	1.1					.6	.5
75				.2	.6					.2	.3	.5
80					.2	.5				.2	.3	.5
>80				.3	.5	.8					.9	.9

TABLE 4. (Continued)

Age 25-34

Hearing Level (dB)	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
					MILITARY							
< 0	17.6	32.1	39.2	28.3	21.1	14.5	22.6	35.7	44.0	33.7	25.0	17.1
5	29.5	32.8	27.2	23.5	19.6	15.7	34.4	34.2	28.8	26.2	23.4	18.6
10	24.6	18.5	15.7	16.9	16.9	15.6	22.2	16.8	13.9	16.7	17.0	16.7
15	17.4	10.4	9.9	13.2	14.3	16.1	13.2	8.5	7.8	10.8	13.0	15.5
20	6.4	3.4	4.0	6.8	8.1	10.6	4.5	2.6	2.7	4.8	6.5	9.8
25	2.8	1.5	2.1	4.1	5.6	8.2	1.8	1.1	1.3	3.0	4.5	6.8
30	.8	.5	.8	2.1	3.3	4.7	.6	.4	.5	1.4	2.5	3.7
35	.4	.3	.5	1.5	2.7	3.6	.3	.2	.3	1.0	1.8	2.6
40	.2	.1	.2	.9	1.8	2.3	.2	.1	.2	.7	1.4	1.8
45	.1	.1	.2	.8	1.6	1.9	.1	.1	.2	.5	1.2	1.5
50	.1		.1	.6	1.3	1.6	.1	.1	.1	.4	.9	1.2
55			.1	.5	1.1	1.3			.1	.4	.9	1.2
60			.1	.3	.8	1.0				.2	.7	.9
65				.2	.7	.9				.2	.5	.7
70				.1	.4	.7				.1	.3	.6
75				.1	.3	.5				.1	.2	.5
80					.2	.3					.1	.3
>80					.2	.7				.1	.2	.5
					CIVILIAN							
< 0	9.6	22.6	27.8	16.6	10.5	7.0	13.9	25.2	33.0	21.6	15.0	10.1
5	26.9	32.9	29.4	21.1	16.3	13.5	33.6	37.9	33.5	25.2	19.6	16.1
10	24.0	20.3	17.2	17.2	15.0	12.5	21.3	18.0	14.0	17.1	15.2	13.6
15	21.6	14.6	12.9	14.4	15.5	16.2	17.9	10.8	9.7	13.7	14.8	15.6
20	8.5	4.5	5.0	8.7	7.9	9.9	6.2	3.7	3.8	6.8	8.1	9.6
25	5.4	2.7	3.5	5.8	8.2	9.8	3.8	1.8	2.4	4.5	5.5	8.7
30	2.0	.8	1.3	3.8	4.4	5.2	1.0	.9	1.1	2.6	3.6	5.2
35	.9	.6	1.0	3.4	3.8	5.1	.8	.5	.6	1.9	3.4	3.8
40	.3	.3	.6	1.9	3.4	3.4	.3	.2	.4	.8	2.7	2.6
45	.3	.2	.3	1.8	3.4	3.3	.3	.3	.4	1.4	2.7	2.9
50	.1	.2	.2	1.3	2.5	2.5	.2	.2	.2	1.0	1.8	1.8
55	.1		.4	1.6	2.7	2.8	.1	.1	.3	1.0	1.8	2.2
60				.9	2.0	2.1		.1	.1	.8	1.7	1.9
65		.1	.1	.8	1.9	2.2	.1	.1	.2	.5	1.8	1.7
70			.1	.4	.9	1.3	.1	.1	.1	.4	.7	1.2
75				.2	.9	1.4			.1	.3	.5	1.4
80				.2	.3	.6			.1		.6	.5
>80				.1	.4	1.3	.1	.1	.1	.3	.5	1.0

TABLE 4. (Continued)

Age 35-44

Hearing Level (dB)	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
					MILITARY							
< 0	17.1	26.8	29.4	17.1	10.3	6.6	19.8	28.5	33.2	20.8	12.3	8.2
5	27.5	31.6	26.5	17.8	11.7	9.1	31.4	33.4	28.9	21.6	14.9	11.2
10	24.9	20.9	17.9	16.8	13.6	11.7	23.4	20.1	17.3	17.6	15.5	13.3
15	18.2	12.4	12.8	14.6	16.5	14.1	15.2	10.9	10.7	14.1	15.2	15.6
20	6.8	4.2	5.7	9.2	10.8	12.2	5.5	3.5	4.3	7.6	10.2	11.7
25	3.2	2.1	3.6	7.2	9.0	10.8	2.6	1.8	2.5	5.7	7.5	9.5
30	1.0	.8	1.4	4.3	6.2	7.3	.8	.5	1.1	3.2	5.1	5.9
35	.5	.5	1.0	3.4	5.0	5.8	.6	.5	.7	2.4	4.0	4.9
40	.2	.3	.6	2.4	4.0	4.2	.2	.2	.5	1.7	3.2	3.6
45	.2	.2	.4	1.9	3.3	3.6	.2	.2	.3	1.6	2.7	3.1
50	.1	.1	.2	1.6	2.8	2.6	.1	.1	.2	1.2	2.1	2.5
55	.1	.1	.2	1.3	2.5	2.7	.1	.1	.2	.9	2.0	2.2
60		.1	.1	1.0	1.8	2.2	.1		.1	.6	1.6	1.8
65			.1	.7	1.5	2.0	.1		.1	.5	1.3	1.6
70				.4	1.1	1.4			.1	.3	.8	1.4
75				.3	.8	1.1				.2	.8	1.2
80				.1	.6	.9				.1	.4	.8
>80				.1	.6	1.5				.1	.6	1.5
					CIVILIAN							
< 0	8.7	16.5	19.0	8.8	5.0	3.2	10.9	18.3	22.0	11.6	6.5	4.8
5	22.7	29.2	24.6	15.4	9.2	8.0	30.2	33.0	29.6	19.6	11.6	9.0
10	22.6	21.0	18.3	13.3	9.7	8.2	19.7	20.2	16.4	15.0	11.5	10.1
15	22.8	15.8	14.8	14.0	12.1	12.0	20.0	14.9	13.6	14.5	14.4	13.4
20	9.7	7.7	7.5	9.2	9.2	10.4	8.2	5.9	6.8	8.4	9.7	10.4
25	7.0	4.7	6.7	8.9	9.6	11.1	5.1	3.3	4.2	7.1	8.5	11.1
30	2.9	1.8	3.1	5.8	7.0	7.3	2.1	1.3	2.0	5.0	5.0	5.9
35	1.7	1.3	1.9	5.3	6.9	7.6	1.7	1.1	1.7	3.4	5.8	6.3
40	.5	.6	1.0	3.7	5.5	5.4	.7	.6	1.0	2.6	4.7	4.2
45	.5	.5	.8	3.2	5.0	4.5	.6	.4	.7	2.8	4.7	4.6
50	.2	.2	.6	2.6	3.4	3.6	.3	.4	.5	2.2	3.2	3.4
55	.2	.2	.6	2.7	4.7	3.7	.2	.3	.4	2.1	3.9	3.3
60	.1	.1	.5	2.4	2.8	3.1	.2	.1	.2	1.6	2.7	2.5
65	.1	.1	.3	1.6	3.4	3.4	.1	.2	.4	1.6	2.5	3.4
70	.2	.1	.2	1.2	2.0	2.0	.1	.1	.1	.9	1.2	1.5
75	.1	.1	.1	.8	1.9	2.1	.1	.1	.2	.7	1.7	1.8
80	.1	.1	.1	.3	.9	1.4		.1	.1	.4	.9	1.4
>80	.1	.1	.1	.7	1.8	3.1	.1	.1	.1	.6	1.8	3.0

TABLE 4. (Continued)

Age 45-54

Hearing Level (dB)	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
					MILITARY							
< 0	16.5	22.7	21.6	9.5	4.9	2.7	16.5	23.7	24.1	11.0	4.9	3.4
5	25.8	29.2	22.3	11.1	5.6	5.1	29.1	31.9	25.5	14.5	8.0	6.1
10	24.9	22.8	17.2	12.3	8.7	7.0	23.2	20.0	17.3	14.0	10.5	8.5
15	18.2	14.1	14.3	13.1	9.5	9.4	17.3	13.2	14.5	13.6	12.5	10.5
20	8.2	5.5	8.9	9.8	9.6	9.8	6.8	5.2	6.0	10.4	9.7	9.6
25	3.6	2.6	5.8	8.4	9.4	10.0	3.4	2.7	5.0	7.9	8.9	9.7
30	1.3	.9	3.1	7.0	7.6	8.6	1.6	1.1	2.6	5.5	6.7	8.1
35	.7	1.0	2.1	5.4	7.5	6.8	1.1	.9	1.7	5.2	6.6	6.7
40	.3	.5	1.6	5.5	6.7	6.5	.3	.3	1.1	3.9	5.3	6.0
45	.2	.3	1.0	4.9	6.0	6.2	.3	.3	.8	3.1	5.3	5.1
50	.2	.1	.8	3.5	5.4	5.2	.2	.2	.3	2.6	4.0	4.8
55	.1	.1	.6	3.0	5.0	4.6	.2	.2	.5	2.8	4.0	4.5
60		.1	.4	2.8	4.0	4.2			.4	2.0	3.7	3.4
65	.1	.1	.2	1.5	3.3	3.4	.1	.1	.2	1.2	3.2	3.5
70			.2	.9	2.4	3.0			.1	1.0	2.2	2.6
75	.1	.1	.1	.7	1.6	2.2				.6	1.3	2.0
80				.3	1.4	1.9			.1	.2	1.1	1.9
>80				.3	1.5	3.5				.5	2.1	3.8
					CIVILIAN							
< 0	4.6	8.8	9.0	3.0	1.0	.9	6.4	9.9	10.7	3.7	1.3	.8
5	16.9	22.6	16.9	7.0	2.9	2.2	21.4	27.3	21.1	9.4	4.2	3.2
10	20.2	20.0	16.2	7.9	4.6	3.6	20.0	19.8	17.3	11.1	5.4	5.1
15	24.0	20.8	18.1	11.3	7.6	7.1	21.8	18.7	16.2	12.7	10.4	7.8
20	12.2	9.7	10.0	9.3	7.2	6.9	10.9	8.8	9.5	9.1	7.1	7.8
25	10.1	7.6	8.6	10.2	8.9	9.4	8.2	6.2	7.5	8.7	9.9	9.8
30	4.1	3.3	5.2	7.3	6.6	7.9	4.0	2.8	4.2	6.7	6.9	8.0
35	3.2	2.3	4.5	7.0	8.3	9.4	2.5	2.2	3.8	6.3	7.2	8.3
40	1.7	1.2	2.7	5.4	6.6	6.3	1.2	1.0	2.0	5.3	6.2	6.4
45	1.0	1.0	2.2	6.2	7.8	7.4	1.1	.8	2.0	5.4	7.4	6.6
50	.6	.7	1.-	5.3	7.2	5.7	.7	.5	1.2	4.5	5.7	5.6
55	.4	.6	1.7	5.9	7.9	6.3	.5	.5	1.4	5.0	6.6	5.8
60	.3	.3	1.3	4.3	5.5	5.1	.3	.5	.8	3.2	5.0	4.7
65	.3	.3	1.0	3.9	5.8	5.1	.3	.2	.8	3.4	4.9	4.9
70	.1	.3	.4	2.3	3.5	4.2	.3	.2	.5	1.8	3.2	3.4
75	.2	.2	.4	1.6	3.3	3.7	.1	.2	.4	1.6	2.9	3.1
80	.1	.2	.3	.8	1.9	3.0	.1	.1	.2	.9	2.0	2.3
>80	.1	.1	.4	1.4	3.5	5.8	.2	.3	.6	1.5	3.9	6.5

TABLE 4. (Continued)

Age 55-64

Hearing Level (dB)	Left Ear Frequency (Hz) 500	1000	2000	3000	4000	6000	Right Ear Frequency (Hz) 500	1000	2000	3000	4000	6000
					MILITARY							
< 0	5.5	11.3	8.8	2.5	1.9	1.7	8.0	14.8	14.3	7.1	3.6	1.4
5	22.5	25.0	15.4	6.6	3.6	1.9	22.5	24.7	15.9	6.9	3.6	4.7
10	25.6	22.5	18.7	8.8	4.4	5.5	19.5	19.2	14.8	7.1	4.4	4.7
15	17.6	13.7	14.6	10.4	5.2	6.3	21.7	17.0	16.5	13.2	8.0	5.0
20	13.5	10.4	10.4	9.6	7.1	4.4	12.4	10.2	9.3	5.2	5.8	5.5
25	8.0	8.8	8.5	9.6	6.3	5.8	7.7	6.0	7.7	7.4	8.2	5.0
30	1.9	1.4	5.0	4.7	7.7	8.0	3.3	2.5	3.3	8.8	6.3	7.1
35	1.7	1.7	5.5	8.2	9.9	6.6	1.7	2.2	4.1	7.4	6.9	7.7
40	1.7	1.1	1.7	6.3	5.0	7.4	.8	.6	2.8	5.2	5.8	7.1
45	.3	1.9	1.9	5.2	8.5	6.0	.8	.8	2.8	5.0	4.7	5.2
50	.3	.6	1.4	5.5	7.4	8.5		.6	1.4	5.2	7.7	7.4
55	1.1	.6	3.3	4.7	5.8	7.1	.8		1.7	5.0	7.7	6.6
60		.3	2.2	7.7	6.9	6.0	.3	.3	1.9	4.1	7.7	7.1
65		.6	1.1	3.9	6.3	7.4		.6	2.5	4.4	4.1	6.0
70			.6	1.7	4.4	3.0	.3	.3	.8	3.0	7.1	4.4
75	.6	.3	.3	1.4	3.3	2.5		.3	.3	2.2	2.8	5.2
80			.3	1.4	1.9	3.6	.3			2.2	2.5	3.6
>80			.6	1.9	4.4	8.2				.6	3.3	6.3
					CIVILIAN							
< 0	2.8	5.4	4.8	1.1	.5	.4	4.0	6.4	6.0	2.0	.5	.3
5	13.0	17.7	11.0	3.1	1.3	1.0	16.7	20.3	14.6	5.0	2.2	1.7
10	17.3	18.1	11.9	5.7	2.1	1.5	17.2	19.0	13.9	7.4	2.5	2.2
15	23.8	21.8	15.8	7.9	4.3	3.8	21.7	19.9	16.1	9.3	5.1	4.1
20	13.8	11.0	11.1	6.1	4.5	3.9	12.8	10.9	10.3	7.8	5.6	5.2
25	11.8	8.7	11.6	9.5	5.8	5.8	10.2	8.8	10.2	9.2	7.7	7.7
30	5.3	4.4	6.6	6.2	5.7	5.4	5.2	3.8	6.1	7.0	6.4	6.8
35	3.7	4.0	5.4	8.1	7.6	7.7	4.8	3.3	5.8	7.2	7.6	7.3
40	2.2	2.5	4.0	6.7	7.0	6.8	1.9	1.7	3.3	5.5	6.3	5.9
45	2.2	1.8	4.5	8.1	8.9	7.9	1.5	1.5	3.6	6.9	8.3	8.3
50	1.5	1.0	2.9	7.2	7.6	7.5	.8	.6	2.4	6.3	7.2	5.7
55	1.0	1.0	3.7	8.6	11.0	9.6	1.0	1.2	1.8	7.9	9.5	8.1
60	.3	.8	2.0	6.0	7.6	7.1	.6	.5	1.9	4.9	6.7	5.8
65	.4	.5	1.8	5.9	7.8	7.6	.2	.7	1.4	4.7	7.1	7.7
70	.2	.4	1.0	3.1	5.4	5.2	.3	.3	.7	2.7	4.5	5.1
75	.3	.2	.5	2.4	4.1	5.1	.5	.4	.8	2.2	4.4	4.5
80	.2	.2	.5	1.5	2.5	3.2	.2	.2	.2	1.2	2.4	3.1
>80	.2	.5	.9	2.8	6.3	10.6	.5	.6	1.0	2.9	6.2	10.5